

## C L A I M S

1. An optical sensor for monitoring combustion processes in a combustion chamber at least consisting of a lens system (1, 2) facing the combustion chamber, a waveguide (5) and a sheath (4) surrounding the lens system and one end of the waveguide characterized in that the lens system (1, 2) comprises at least one essentially plano-concave lens (1) and a double concave lens (2) wherein the planar face of the plano-concave lens (1) is exposed to the combustion chamber.
2. A sensor according to claim 1 characterized in that the angular coverage of the lens system (1, 2) is at least  $130^\circ$ , preferably at least  $135^\circ$ , in particular up to  $140^\circ$ .
3. A sensor according to claim 1 characterized in that the lenses (1, 2) are composed of sapphire or quartz glass.
4. A sensor according to claim 1 characterized in that at least the plano-concave lens (1) at its surface area is surrounded by a metal plating.
5. A sensor according to claim 4 characterized in that the plano-concave lens (1) is fixed to the sheath (4) by means of a soldering material.
6. A sensor according to claim 1 characterized in that the lens system (1, 2) has a maximum diameter of  $< 8$  mm, preferably of  $< 5$  mm, in particular of  $< 2.4$  mm.
7. A sensor according to claim 1 characterized in that the length of the lens system (1, 2) which has to be passed by the light is at most equal to the diameter, preferably

between 50 and 75% of the diameter of the lens system (1, 2).

8. A sensor according to claim 1 characterized in that the outer diameter of the sheath (4) is at most 10 mm, preferably at most 6.5 mm, in particular about 3.5 mm.
9. A sensor according to claim 1 characterized in that the sensor can be assembled in a spark plug or in a heater plug.
10. A sensor according to claim 1 characterized in that the slackness (3) between the outer radius of the lenses (1, 2) and the inner radius of the sheath (4) is less than 10  $\mu\text{m}$ , preferably about 5  $\mu\text{m}$ .
11. A sensor according to claim 3 characterized in that at least the lens (1) facing the combustion chamber is fixed by means of a soldering material to the sheath (4) in the area of the gap (3).
12. A sensor according to claim 1 characterized in that the sheath (4) is made of a material able to withstand a continuous temperature load of 600°C and a momentary temperature load of 950°C.
13. A sensor according to claim 1 characterized in that the sheath (4) is made of a material having a coefficient of thermal expansion in the range of 0 to 400°C of less than  $10.5 \cdot 10^{-6} \text{ K}^{-1}$ , particularly of less than  $7 \cdot 10^{-6} \text{ K}^{-1}$ .
14. A method for the centering of one or more lenses (1, 2) and a waveguide (5) in a sheath (4) of an optical sensor for the monitoring of combustion processes in a combustion chamber characterized in that the gap (3) between the outer radius of the lenses (1, 2) and the

inner radius of the sheath (4) is less than 10  $\mu\text{m}$ , preferably about 5  $\mu\text{m}$ , and that the gap (3) is filled with a soldering paste and that the deviation of the axial orientation of the waveguide (5) and the lens system (1, 2) is less than 10  $\mu\text{m}$ , preferably less than 5  $\mu\text{m}$ .

15. The method according to claim 14 characterized in that a deep-drawn sheath (4) is used.
16. The method according to claim 14 characterized in that the sensor comprises a lens system (1, 2) having at least two lenses (1, 2).
17. The method according to claim 14, characterized in that the sensor consists of at least a lens system (1, 2) facing the combustion chamber, a waveguide (5) and a sheath (4) surrounding the lens system and one end of the waveguide wherein the lens system (1, 2) comprises at least one essentially plano-concave lens (1) and a double concave lens (2) and wherein the planar face of the plano-concave lens (1) is exposed to the combustion chamber.
18. The method according to claim 17, characterized in that the angular coverage of the lens system (1, 2) is at least 130°, preferably at least 135°, in particular up to 140°.
19. The method according to claim 17, characterized in that the lenses (1, 2) are composed of sapphire or quartz glass.
20. The method according to claim 17, characterized in that at least the plano-concave lens (1) at its surface area is surrounded by a metal plating.

21. The method according to claim 20, characterized in that the plano-concave lens (1) is fixed to the sheath (4) by means of a soldering material.
22. The method according to claim 17, characterized in that the lens system (1, 2) has a maximum diameter of  $< 8$  mm, preferably of  $< 5$  mm, in particular of  $< 2.4$  mm.
23. The method according to claim 17, characterized in that the length of the lens system (1, 2) which has to be passed by the light is at most equal to the diameter, preferably between 50 and 75% of the diameter of the lens system (1, 2).
24. The method according to claim 17, characterized in that the outer diameter of the sheath (4) is at most 10 mm, preferably at most 6.5 mm, in particular about 3.5 mm.
25. The method according to claim 17, characterized in that the sensor can be assembled in a spark plug or in a heater plug.
26. The method according to claim 17, characterized in that the slackness (3) between the outer radius of the lenses (1, 2) and the inner radius of the sheath (4) is less than 10  $\mu\text{m}$ , preferably about 5  $\mu\text{m}$ .
27. The method according to claim 19, characterized in that at least the lens (1) facing the combustion chamber is fixed by means of a soldering material to the sheath (4) in the area of the gap (3).
28. The method according to claim 17, characterized in that the sheath (4) is made of a material able to withstand a continuous temperature load of  $600^{\circ}\text{C}$  and a momentary temperature load of  $950^{\circ}\text{C}$ .

29. The method according to claim 17, characterized in that the sheath (4) is made of a material having a coefficient of thermal expansion in the range of 0 to 400°C of less than  $10.5 \cdot 10^{-6} \text{ K}^{-1}$ , particularly of less than  $7 \cdot 10^{-6} \text{ K}^{-1}$ .